MOTOROLA

AlphaMate 250

Installation Manual
6880450F70-O

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CAUTION
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Section One: Introduction

1 What the AlphaMate 250 Does

The AlphaMate 250 is a small desk-top unit that enables an operator to send alphanumeric messages to alphanumeric radio pagers through one or more paging services.

When a person wants to send a message, the operator types the name of the person the message is intended for, and the message. The AlphaMate 250 automatically contacts the appropriate paging service company, and has the message transmitted.

The AlphaMate 250 can be used to reach up to 250 pagers, and up to 16 paging service providers. It has a standard typewriter keyboard with ten function keys for selecting operations, and a screen that displays the operations (see figure 1-1).

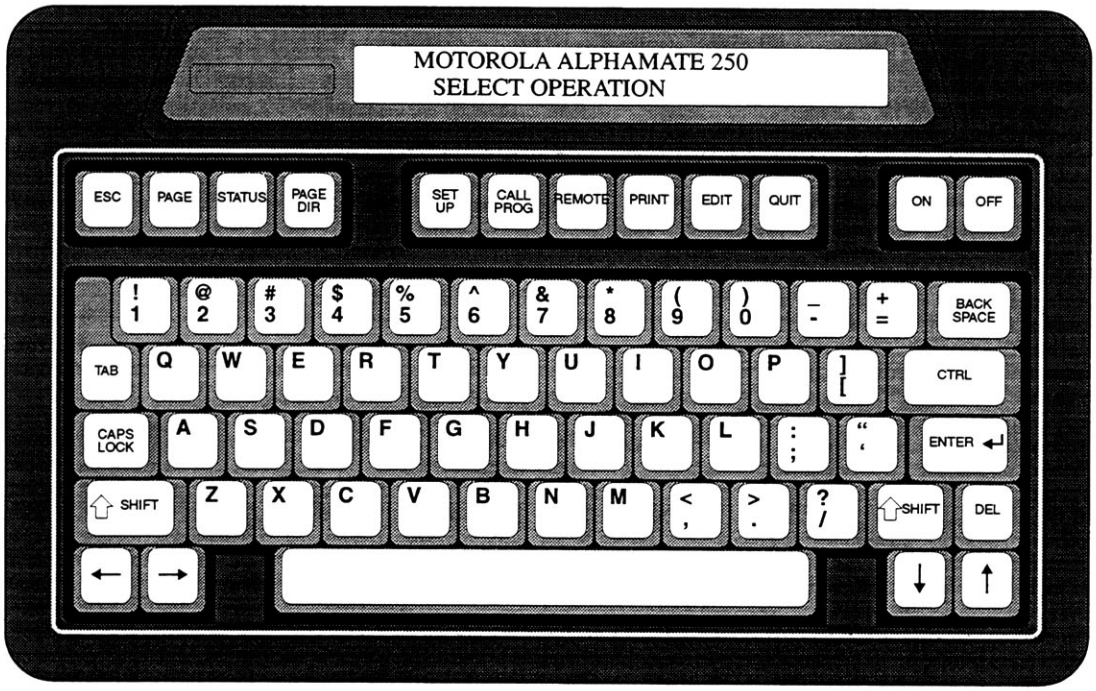


Figure 1-1: The Alphamate 250 Keyboard and Display

2 Alphamate 250 Characteristics

The basic AlphaMate 250 characteristics are:

- It plugs into a standard 115 Vac or 230 Vac supply.

Note: For 230-Vac operation an appropriate ac adapter is required.

- A lithium battery for maintaining memory data during temporary power outages.
- Connects to one or more paging systems by way of a standard analog telephone line and/or an RS-232 serial port.
- Has an automatic telephone dialer with either dial-pulse or touch-tone signaling; the internal memory stores a primary and a secondary number for each paging system connection.
- Has a modem for exchanging data with the paging terminal when a telephone link is used.
- Can drive a serial printer through a standard RS-232 port.
- Supports remote programming through another AlphaMate 250 unit or a standard computer terminal.

3 The Contents of this Manual

This manual covers installing and servicing the AlphaMate 250 in the following sections:

- **Section Two: Installation** - This section explains how to make the various connections to the AlphaMate 250.
- **Section Three: Testing** - This section explains the standard self-test used on start-up, and the optional diagnostic routines provided.
- **Section Four: Setting Up the AlphaMate 250** - This section explains how to set up the unit to suit the operator and the installation.
- **Section Five: Theory of Operation** - This section explains how the AlphaMate 250 is organized, and how the subsystems function.
- **Section Six: Servicing Information** - This section provides various reference information that can be useful if the AlphaMate 250 needs service.

Notes

Section Two: Installation

1 Equipment Check

When unpacking the AlphaMate 250, and before installing it, check it carefully for evidence of physical damage:

- Is the case cracked, scratched, or damaged in any other way?
- Are the connector housings bent or broken, or are pins missing?
- Are all the keycaps in place on the keyboard?
- Is the display glass cracked?

Report any problems to the shipper immediately, and arrange with Motorola to have the unit replaced.

2 Installation Requirements

2.1 Environmental Requirements

The AlphaMate 250 was designed to work in a normal office environment. Heavy dust, moisture, or corrosive particles in the air will shorten the life of the product. The AlphaMate 250 can withstand slow variations of temperature between 0 and 50°C (32 and 122°F).

2.2 Power Requirements

The AlphaMate 250 operates on either 115 Vac or 230 Vac, at either 50 or 60 Hz. A separate power supply plugs into a standard wall outlet, and provides 7.5 Vdc through an attached cord to the AlphaMate 250.

Note: For 230-Vac operation an appropriate ac adapter is required.

The power supply should be located so that it cannot be unplugged inadvertently.

CAUTION
Make sure that the power cord is not laid across the floor in a location where it may trip passers-by.

2.3 Battery

The AlphaMate is equipped with a lithium battery with a normal shelf life of five years or more. It requires no attention during installation, but should be replaced routinely after about five years of service.

2.4 Telephone Line

The AlphaMate 250 connects to a standard analog telephone line through a female RJ-11 connector. Use a telephone extension cord with male RJ-11 connectors.

The AlphaMate loads the telephone with a Ringer Equivalence Number (REN) of 0.38. Since a telephone line can accept a load of up to 5 REN, the AlphaMate does not cause any service degradation.

2.5 Telephone

A second female RJ-11 connector on the AlphaMate 250 allows the connection of an optional telephone. This telephone and the AlphaMate share access to the telephone line.

2.6 Printer

An optional printer can be connected to the AlphaMate 250. The printer uses an RS-232 serial connection. A suitable cable is described in table 2-1.

3 AlphaMate 250 Connections

Four connections can be made to an AlphaMate 250 (see figure 2-1).

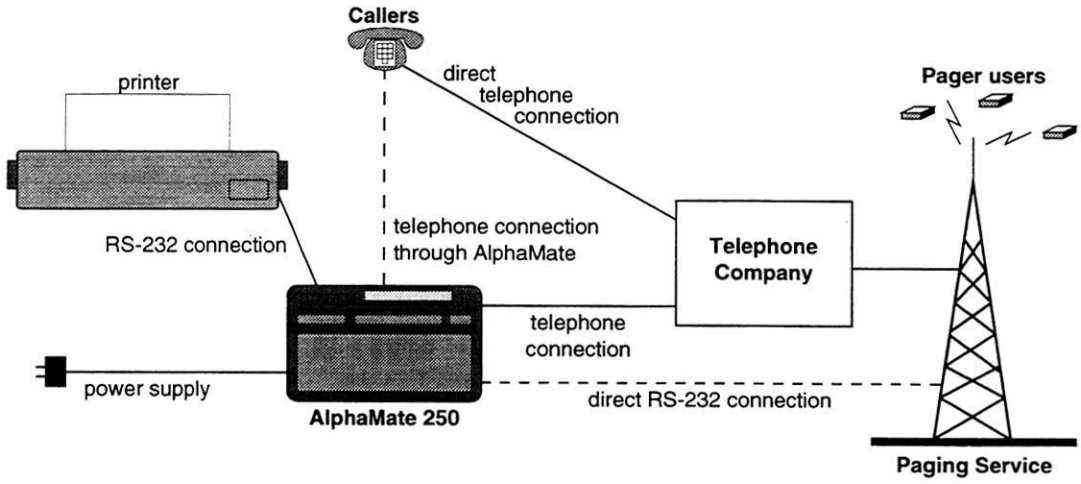


Figure 2-1: AlphaMate 250 Connections to the Telephone and Paging Systems

All connectors are located on the back of the AlphaMate (see figure 2-2).

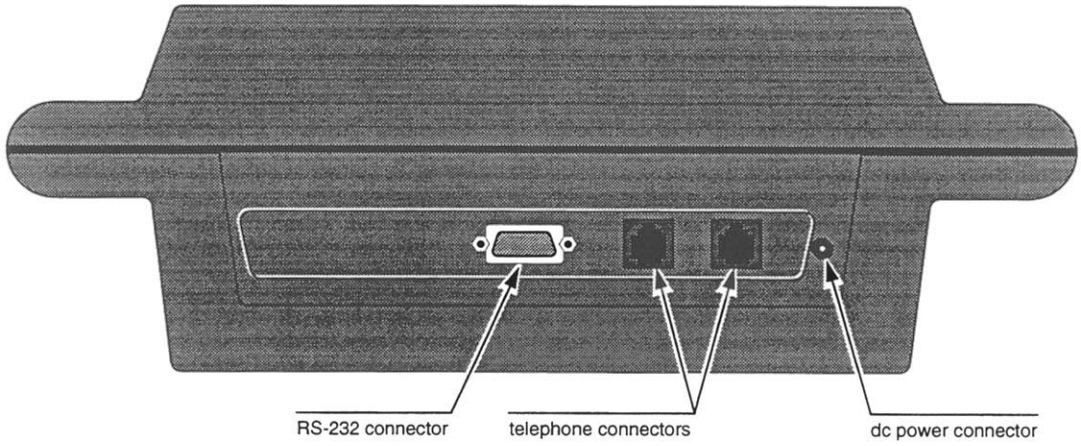


Figure 2-2: The Connectors on the Back of the AlphaMate 250

3.1 Power Supply

Plug the power supply into a wall outlet with the appropriate voltage. Plug the free end of the power cable into the mating dc power connector on the AlphaMate 250.

3.2 Telephone Line

If the AlphaMate 250 is connected to one or more paging systems through a standard analog telephone line, connect the line to either of the two RJ-11 connectors on the AlphaMate 250.

3.3 RS-232 Serial Link

If the AlphaMate 250 is connected to one or more paging systems through an RS-232 serial data link, connect the link to the 9-pin male RS-232 connector on the AlphaMate 250. The cable uses a 9-pin female D connector at the AlphaMate end; the connector on the other end of the cable depends on the paging switch. The connections within the cable also depend on the paging switch (see table 2-1, table 2-2, and table 2-3).

Note: Serial link cables are not included with the AlphaMate 250.

Table 2-1: RS-232 Connections to a People Finder Paging Switch or Serial Printer

Signal Name	AlphaMate 9-pin female D connector	People Finder 25-pin male D connector
RXD	2	2
TXD	3	3
CTS	8	20
RTS	7	5, 6, and 8
Signal GND	5	7
unconnected	all other pins	all other pins

Table 2-2: RS-232 Connections (Page Bridge)

Signal Name	AlphaMate 9-pin female D connector	Page Bridge 25-pin male D connector
RXD	2	3
TXD	3	2
CTS	8	5, 6, and 8
RTS	7	20
Signal GND	5	7
unconnected	all other pins	all other pins

Table 2-3: RS-232 Connections (M15 Series Switch)

Signal Name	AlphaMate 9-pin female D connector	M15 Series 25-pin male D connector
DCD	1	1
RT	2	3
TX	3	2
DTR	4	6
Signal GND	5	5
DSR	6	4
RTS	7	8
CTS	8	7
RI	9	9
unconnected		all other pins

3.4 Telephone

If a telephone shares the line with the AlphaMate, connect it to the second RJ-11 connector on the AlphaMate 250.

CAUTION
The AlphaMate cannot place paging calls while the telephone is in use. For this reason, sharing the line between the AlphaMate and a telephone is recommended only when paging traffic and telephone traffic are both relatively low.

3.5 Other RS-232 Connector Applications

The RS-232 port on the AlphaMate 250 appears on a male 9-pin subminiature connector. This port is configured as a Data Terminal Equipment (DTE) port in accordance with EIA standard RS-232D. A cable plugged into this connector can be used to connect the AlphaMate 250 to another AlphaMate 250, or to other computer equipment (see table 2-4).

Table 2-4: RS-232 Serial Connections

Signal Name	AlphaMate 9-pin female D connector	9-pin male D connector to other equipment
RXD	2	3
TXD	3	2
CTS	8	7
RTS	7	8
Signal GND	5	5
unconnected	all other pins	all other pins

When this port is used for a printer, connect power to the printer, and configure the printer according to the manufacturer's instructions.

Notes

Section Three: Testing

1 Operating the Alphamate

The AlphaMate 250 has a standard typewriter keyboard with ten function keys for selecting operations, and a screen that displays the operations (see figure 3-1).

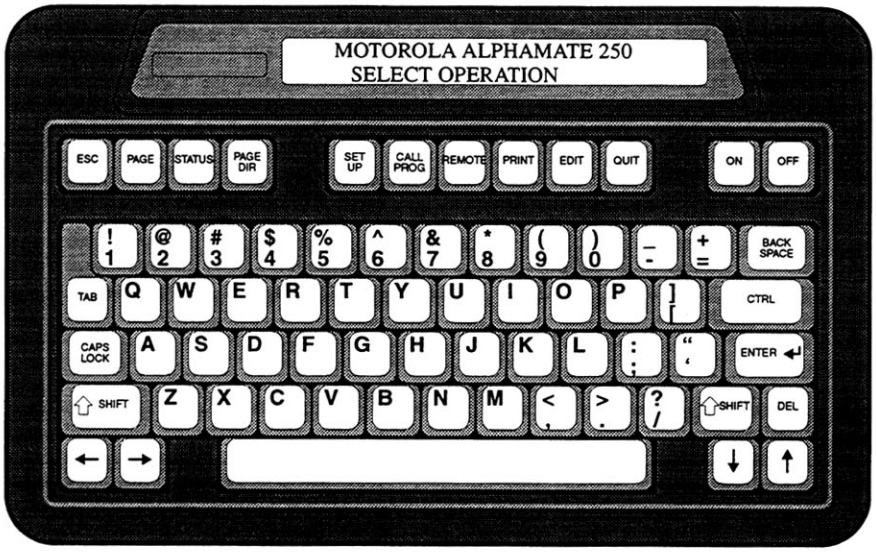
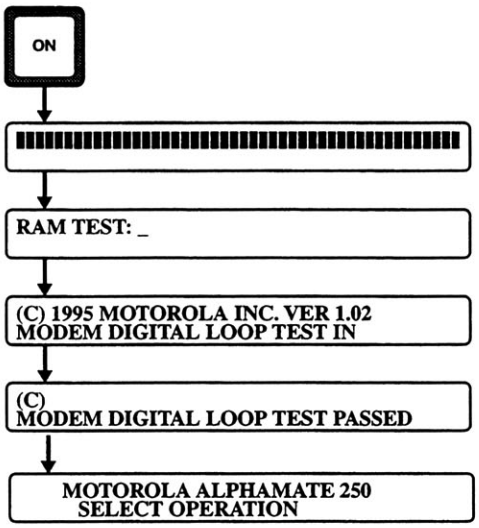


Figure 3-1: The AlphaMate 250 Keyboard and Display

Using the AlphaMate 250 involves pressing a function key to select a specific operation. This produces a menu of several items. One item is flashing to indicate that it is preselected. To change the selection, press the ← and → keys to move to other selections on the same line. To change lines, use the ↓ and ↑ keys. To make the selection once the right item is flashing, press the **ENTER** key.

2 Initial Start-up and Self-test

When all the connections to the AlphaMate 250 are complete, press the **ON** key. The AlphaMate powers up, and runs through a series of self-tests, as the messages on the display indicate:



This *Select Operation* screen is the standard display that an operator usually returns to between operations. After any operation you can return to this screen by pressing the **QUIT** key.

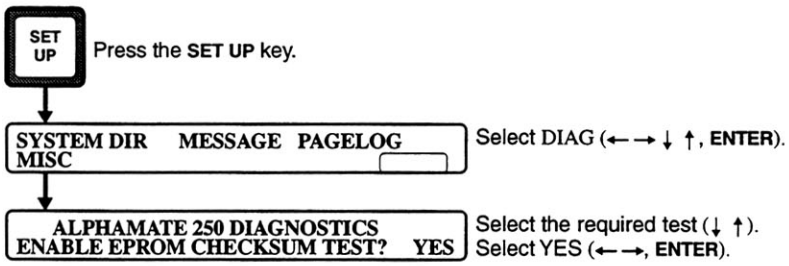
3 Other Diagnostic Routines

Specialized diagnostic routines are programmed into the AlphaMate 250 to verify the function of specific parts. The tests are:

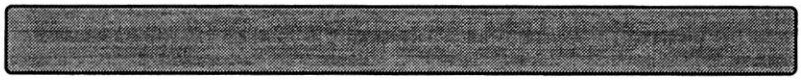
- EPROM Checksum,
- Modem Digital Loop,
- Modem Analog Loop,
- Keyboard,
- LCD Blank,
- LCD Pixel,
- LCD Contrast,
- LCD Character,
- Battery Test.

3.1 Starting the Diagnostic Routines

All diagnostic tests begin the same way.



The item **SYSTEM DIR** is flashing. Select **DIAG**, and press the **ENTER** key. The *Diagnostic* menu appears:



To execute a test, use the ↓ and ↑ keys to find the required test, then select **YES** and press the **ENTER** key.

3.2 The Modem Digital Loop Test

This test verifies that the modem can communicate with the microcontroller.

When the test passes, the AlphaMate displays the message **MODEM DIGITAL LOOP TEST PASSED**. When the test fails, the AlphaMate displays the message **MODEM DIGITAL LOOP TEST FAILED [n]**, where "n" represents a number indicating the type of failure. The various failure codes are listed in table 3-1. Press the **ENTER** key to continue.

Table 3-1: Modem Digital Loop Test Failure Codes

Code	Failure
0	Serial port inoperable
1	Serial port write failure (FFs)
2	FFs not looped back
3	Serial port write failures (0s)
4	0s not looped back
5	Serial port write failure (55s)
6	55s not looped back
7	Serial port write failure (AAs)
8	AAs not looped back

3.3 The Modem Analog Loop Test

This test verifies that the transmitter and receiver of the modem are functional. This is done by looping the output of the transmitted back into the input of the receiver.

When the test passes, the AlphaMate displays the message **MODEM ANALOG LOOP TEST PASSED**. When the test fails, the AlphaMate displays the message **MODEM ANALOG LOOP TEST FAILED [n]**, where "n" represents a number indicating the type of failure. The various failure codes are listed in table 3-2. Press the **ENTER** key to continue.

Table 3-2: Modem Analog Loop Test Failure Codes

Code	Failure		Code	Failure
0	Serial port inoperable		11	Serial port inoperable
1	Modem not installed		12	No carrier detected
2	No carrier detected		13	Scrambled binary 1s not detected
3	Serial port write failure (FFs)		14	Serial port write failure (FFs)
4	FFs not looped back		15	FFs not looped back
5	Serial port write failure (0s)		16	Serial port write failure (0s)
6	0s not looped back		17	0s not looped back
7	Serial port write failure (55s)		18	Serial port write failure (55s)
8	55s not looped back		19	55s not looped back
9	Serial port write failure (AAs)		20	Serial port write failure (AAs)
10	AAs not looped back		21	AAs not looped back

3.4 The Keyboard Test

This test verifies the functionality of the AlphaMate keyboard. This is an interactive test: in the course of it, you will be asked to press specific keys. The AlphaMate responds instantly in each case, telling if there is an error with a particular key.

3.5 The LCD Blank Test

This test verifies that all the pixels in the Liquid Crystal Display (LCD) turn off. When you enable the test, the entire display blinks on and off with the message:

```
WHEN SCREEN BLANK, ARE ALL PIXELS
OFF?
```

When the message is not displayed, the entire screen should be blank. Check that all pixels are off, then press either the Y key or the N key to report what you see. The AlphaMate then displays the appropriate message **LCD BLANK TEST PASSED** or **LCD BLANK TEST FAILED [1]**. Press the **ENTER** key to continue.

3.6 The LCD Pixel Test

This test verifies that all the pixels in the Liquid Crystal Display (LCD) turn on. In other words, it is precisely the opposite of the LCD blank test. When you enable this test, the entire display blinks on and off with the message:

```
WHEN SCREEN DARK, ARE ALL PIXELS
ON?
```

When the message is not displayed, the entire screen should be dark. Check that all pixels are on, then press either the Y key or the N key to report what you see. The AlphaMate then displays the appropriate message **LCD PIXEL TEST PASSED** or **LCD PIXEL TEST FAILED [1]**. Press the **ENTER** key to continue.

3.7 The LCD Contrast Test

This test verifies that the Liquid Crystal Display (LCD) contrast can vary properly. When you enable this test, the entire display slowly fades on and off with the message:

```
CONTRAST VARIES FROM FULL ON TO
OFF?
```

Check that the display is varying appropriately, then press either the Y key or the N key to report what you see. The AlphaMate then displays the appropriate message **LCD CONTRAST TEST PASSED** or **LCD CONTRAST TEST FAILED [1]**. Press the **ENTER** key to continue.

3.8 The LCD Character Test

This test verifies that the Liquid Crystal Display (LCD) can display its complete character-set. When you enable this test, the entire display shows a group of characters, which you must check for correctness:

```
ARE THE FOLLOWING CHARACTERS COR-
RECT?:
```

Check that the display is displaying the characters correctly, then press either the Y key or the N key to report what you see. The AlphaMate displays several other blocks of characters, until the entire character-set has been checked. The AlphaMate then displays the appropriate message **LCD CHARACTER TEST PASSED** or **LCD CHARACTER TEST FAILED [1]**. Press the **ENTER** key to continue.

Notes

Section Four: Setting Up the AlphaMate 250

1 Introduction

Some AlphaMate 250 operations must be configured before the unit can be used. These setups can be modified as circumstances require.

Some of the basic setups can be done by the operator. Others should be done by an installer.

All setup operations begin by pressing the **SETUP** key. The AlphaMate 250 displays the *Setup* menu:

```
SYSTEM DIR   MESSAGE  PAGELOG  MISC
CONFIGURATION  PASSWORD  PRINTER  DIAG
```

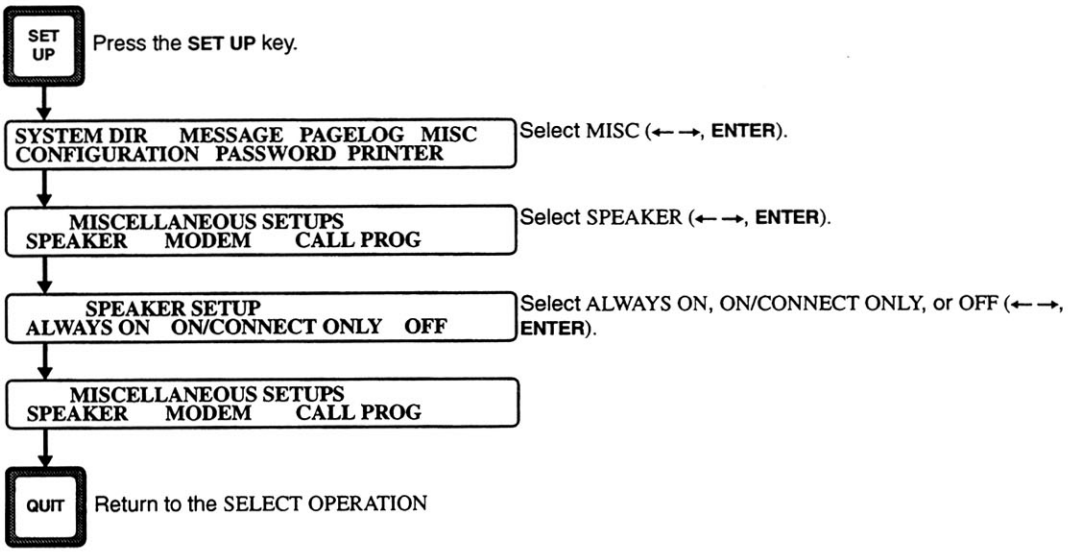
This menu offers the following choices:

- **SYSTEM DIR** - Used by the operator to set up the System Directory.
- **MESSAGE** - Used by the operator to set up preset (canned) messages.
- **PAGELOG** - Used by the operator to log pages to the printer.
- **MISC** - Miscellaneous setups (the speaker, call progress and the modem setup) used by the installer initially, and by the operator afterwards.
- **CONFIGURATION** - Used by the installer to configure the AlphaMate 250.
- **PASSWORD** - Used by the installer initially, and by the operator afterwards, to set up a user password.
- **PRINTER** - Used by the installer to set up a printer (if used).
- **DIAG** - Used by the installer if a problem is detected.

This section describes all the operations used by the installer. Operations performed only by the operator are described in the *AlphaMate 250 Operator's Manual* (6880450F40).

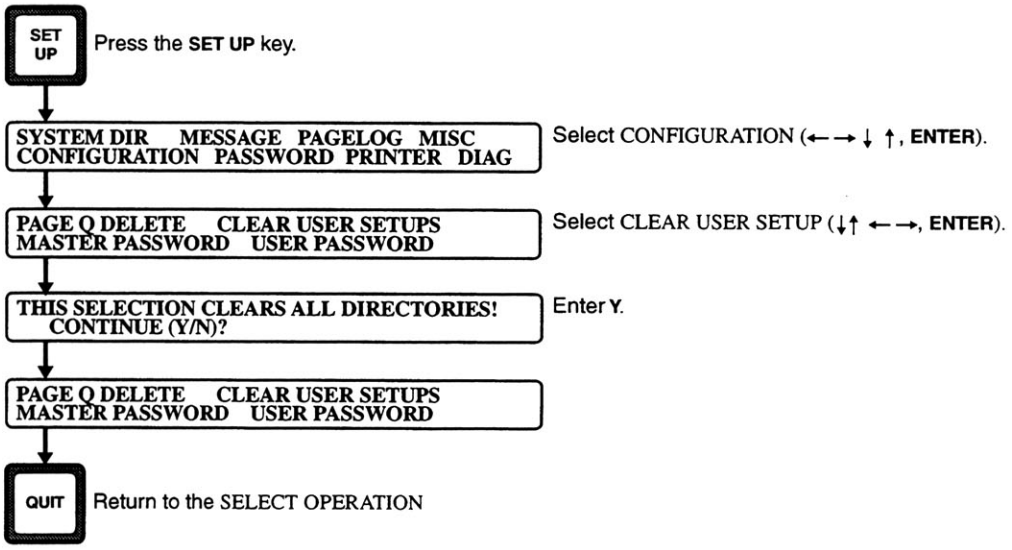
2 Turning the Speaker On

- ALWAYS ON means that you hear all the sounds on the telephone line. This is mainly useful for debugging problems.
- ON/CONNECT ONLY means that you hear only what occurs after the connection is made to the paging system service. (Modem signals are suppressed.) This is useful for monitoring call progress.



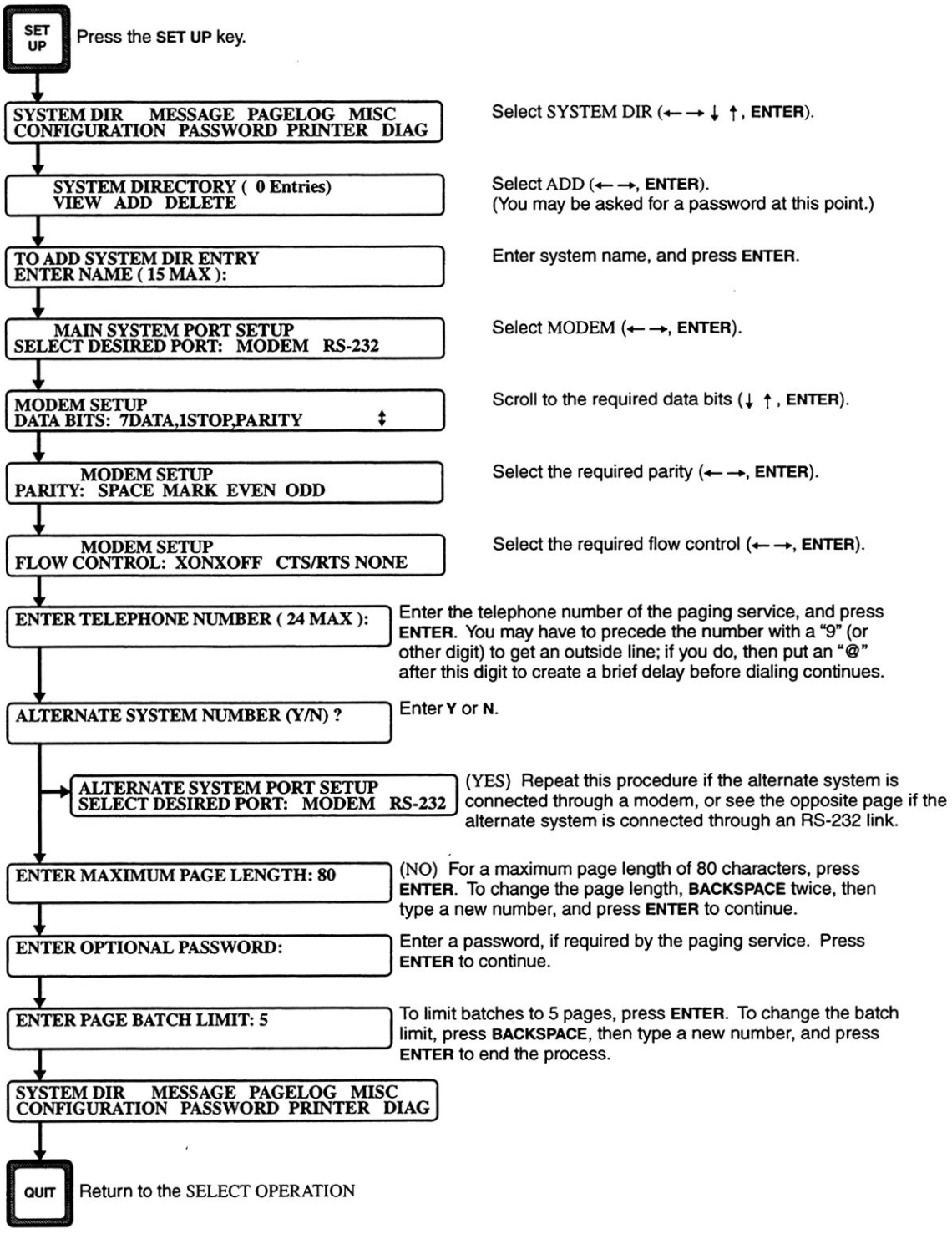
3 Clearing User Setups

- This operation deletes all information from all directories. An example use of this function is in reinstalling an AlphaMate 250 in a new location.



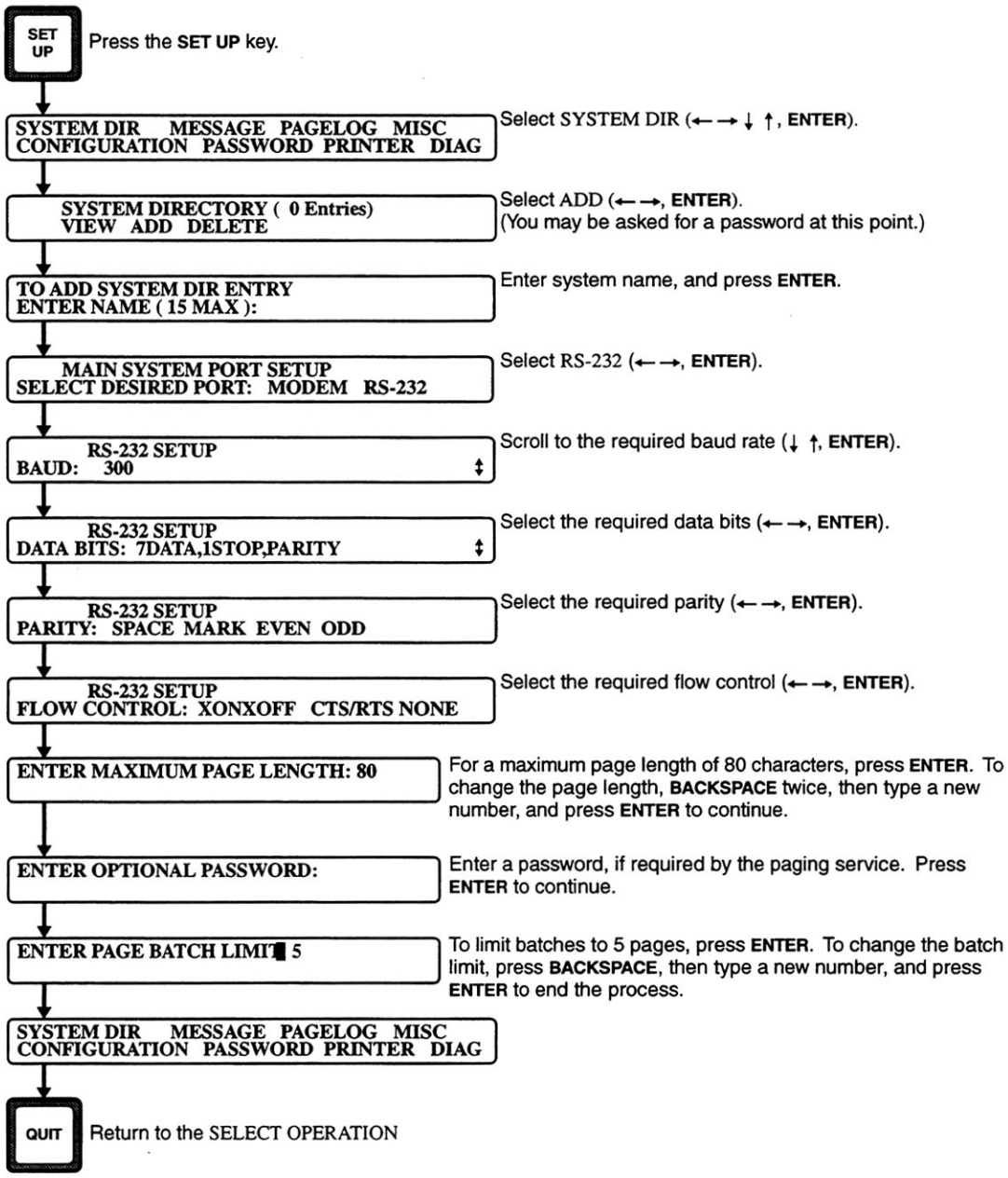
4 Adding a New Paging Service Using a Telephone (Modem) Connection

- You must have at least one system (paging service).
- The AlphaMate 250 can connect to up to 16 systems.
- Check the maximum acceptable message length imposed by each paging service. The AlphaMate 250 accepts up to 240 characters.
- Check the maximum number of pages per batch imposed by each paging service.
- Check if each paging service requires a password.


SET UP
Press the SET UP key.
SYSTEM DIR MESSAGE PAGELOG MISC
CONFIGURATION PASSWORD PRINTER DIAG
Select SYSTEM DIR (← → ↓ ↑, ENTER).
SYSTEM DIRECTORY (0 Entries)
VIEW ADD DELETE
Select ADD (← →, ENTER).
(You may be asked for a password at this point.)
TO ADD SYSTEM DIR ENTRY
ENTER NAME (15 MAX):
Enter system name, and press ENTER.
MAIN SYSTEM PORT SETUP
SELECT DESIRED PORT: MODEM RS-232
Select MODEM (← →, ENTER).
MODEM SETUP
DATA BITS: 7DATA,1STOP,PARITY
Scroll to the required data bits (↓ ↑, ENTER).
MODEM SETUP
PARITY: SPACE MARK EVEN ODD
Select the required parity (← →, ENTER).
MODEM SETUP
FLOW CONTROL: XONXOFF CTS/RTS NONE
Select the required flow control (← →, ENTER).
ENTER TELEPHONE NUMBER (24 MAX):
Enter the telephone number of the paging service, and press ENTER. You may have to precede the number with a "9" (or other digit) to get an outside line; if you do, then put an "@" after this digit to create a brief delay before dialing continues.
ALTERNATE SYSTEM NUMBER (Y/N) ?
Enter Y or N.
ALTERNATE SYSTEM PORT SETUP
SELECT DESIRED PORT: MODEM RS-232
(YES) Repeat this procedure if the alternate system is connected through a modem, or see the opposite page if the alternate system is connected through an RS-232 link.
ENTER MAXIMUM PAGE LENGTH: 80
(NO) For a maximum page length of 80 characters, press ENTER. To change the page length, BACKSPACE twice, then type a new number, and press ENTER to continue.
ENTER OPTIONAL PASSWORD:
Enter a password, if required by the paging service. Press ENTER to continue.
ENTER PAGE BATCH LIMIT: 5
To limit batches to 5 pages, press ENTER. To change the batch limit, press BACKSPACE, then type a new number, and press ENTER to end the process.
SYSTEM DIR MESSAGE PAGELOG MISC
CONFIGURATION PASSWORD PRINTER DIAG
QUIT
Return to the SELECT OPERATION

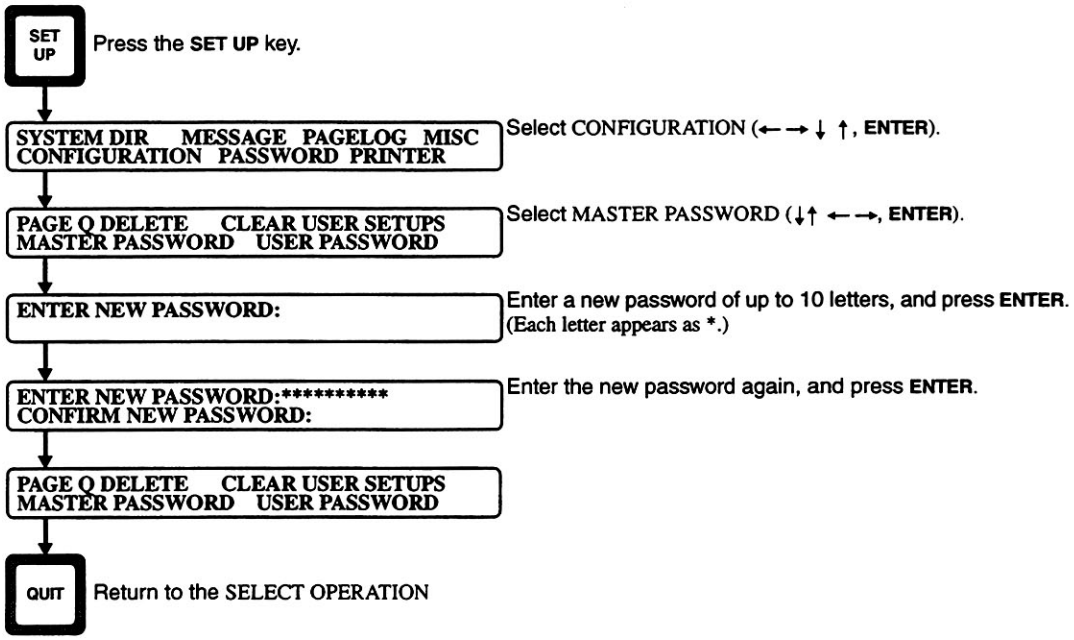
5 Adding a New Paging Service Using an RS-232 Link

- You must have at least one system (paging service).
- The AlphaMate 250 can connect to up to 16 systems.
- Check the maximum acceptable message length imposed by each paging service. The AlphaMate 250 accepts up to 240 characters.
- Check the maximum number of pages per batch imposed by each paging service.
- Check if each paging service requires a password.


SET UP
Press the SET UP key.
SYSTEM DIR MESSAGE PAGELOG MISC
CONFIGURATION PASSWORD PRINTER DIAG
Select SYSTEM DIR (← → ↓ ↑, ENTER).
SYSTEM DIRECTORY (0 Entries)
VIEW ADD DELETE
Select ADD (← →, ENTER).
(You may be asked for a password at this point.)
TO ADD SYSTEM DIR ENTRY
ENTER NAME (15 MAX):
Enter system name, and press ENTER.
MAIN SYSTEM PORT SETUP
SELECT DESIRED PORT: MODEM RS-232
Select RS-232 (← →, ENTER).
RS-232 SETUP
BAUD: 300
Scroll to the required baud rate (↓ ↑, ENTER).
RS-232 SETUP
DATA BITS: 7DATA,1STOP,PARITY
Select the required data bits (← →, ENTER).
RS-232 SETUP
PARITY: SPACE MARK EVEN ODD
Select the required parity (← →, ENTER).
RS-232 SETUP
FLOW CONTROL: XONXOFF CTS/RTS NONE
Select the required flow control (← →, ENTER).
ENTER MAXIMUM PAGE LENGTH: 80
For a maximum page length of 80 characters, press ENTER. To change the page length, BACKSPACE twice, then type a new number, and press ENTER to continue.
ENTER OPTIONAL PASSWORD:
Enter a password, if required by the paging service. Press ENTER to continue.
ENTER PAGE BATCH LIMIT 5
To limit batches to 5 pages, press ENTER. To change the batch limit, press BACKSPACE, then type a new number, and press ENTER to end the process.
SYSTEM DIR MESSAGE PAGELOG MISC
CONFIGURATION PASSWORD PRINTER DIAG
QUIT
Return to the SELECT OPERATION

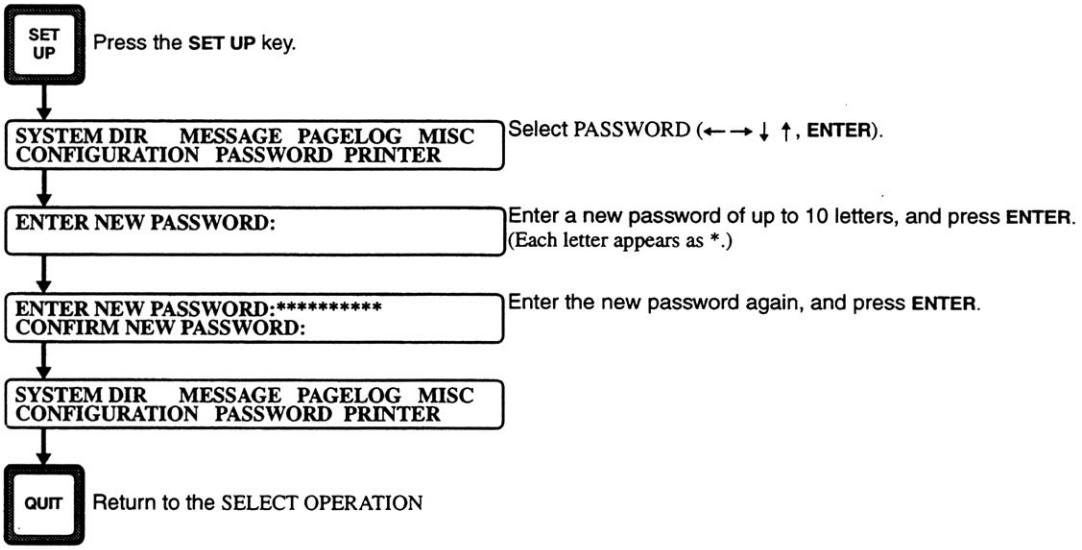
6 Entering a Master Password

- The System Directory can be accessed through the CONFIGURATION menu (which is protected by the master password), and also through the SETUP menu (which is not protected by the master password). Paging services entered in the System Directory by way of the CONFIGURATION menu can be changed only by the same method, using the master password. However, other paging services entered in the System Directory by way of the SETUP menu can still be changed by the same method without needing a master password.
- Always keep a record of your password! It is impossible to access many AlphaMate 250 functions without it!



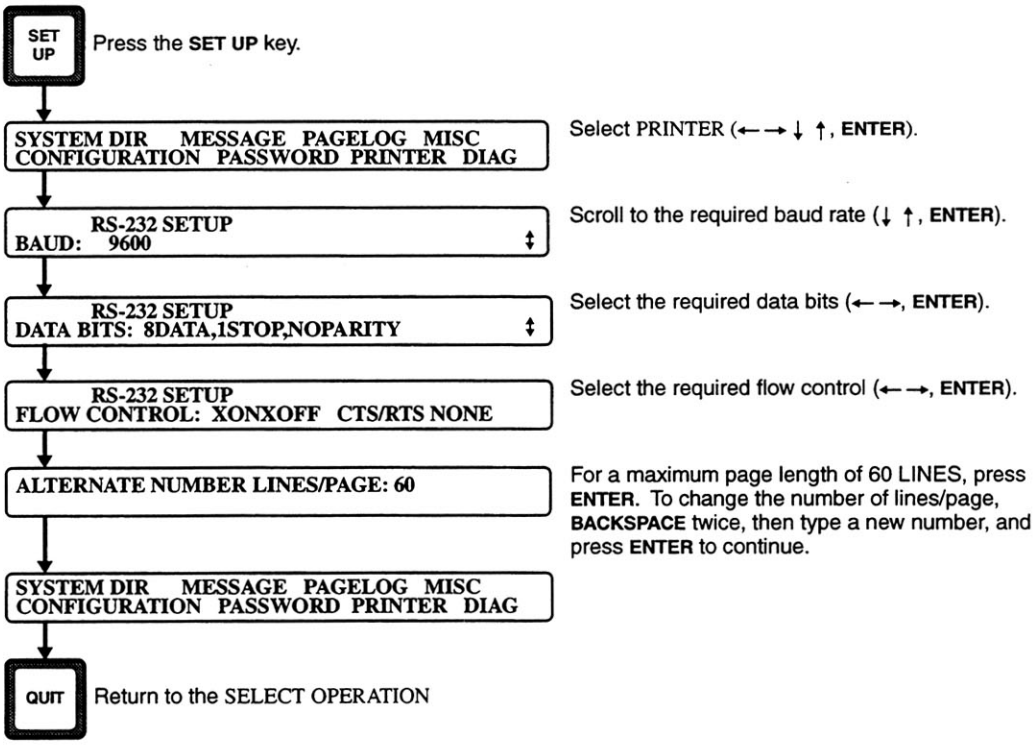
7 Entering a User Password

- A user password can be used to prevent unauthorized people from changing the data in the directories, such as the pager directory, system directory, and canned messages directory.
- Always keep a record of your password! It is impossible to access many AlphaMate 250 functions without it!



8 Setting Up a Printer

- A printer can be used to log pages, and to print out copies of the directories.
- This serial printer is connected to the RS-232 port.



Section Five: Theory of Operation

1 System Organization

The AlphaMate 250 circuitry is organized into functional subsystems (see figure 5-1). These subsystems have the following functions:

- Microcontroller - An 80C451 Microcontroller controls all operations of the AlphaMate 250.
- Memory - 32K bytes of RAM are used to store data, and 128K bytes of EPROM are used to store the program.
- Keyboard - A 69-key keyboard, consisting of a standard set of typewriter keys plus specialized function keys, allows the user to enter data into the AlphaMate 250.
- Display - An 80-character liquid crystal display allows the AlphaMate 250 to present data to the user.
- Modem and Dial Access Arrangement - These circuits control access to a standard analog telephone line.
- RS-232 Interface - This EIA-standard interface can be used as an alternative to the telephone line for accessing paging systems, as a serial printer port, or as a direct connection to other AlphaMate 250s for exchanging data.
- Power Supply - This circuitry provides regulated 5 Vdc to the circuitry within the AlphaMate 250, and controls RAM chip selection and provides battery backup for the RAM when the power is off. This circuitry also provides power-fail and reset signals to the Microcontroller.

The functions of these subsystems are described in more detail in the rest of this section.

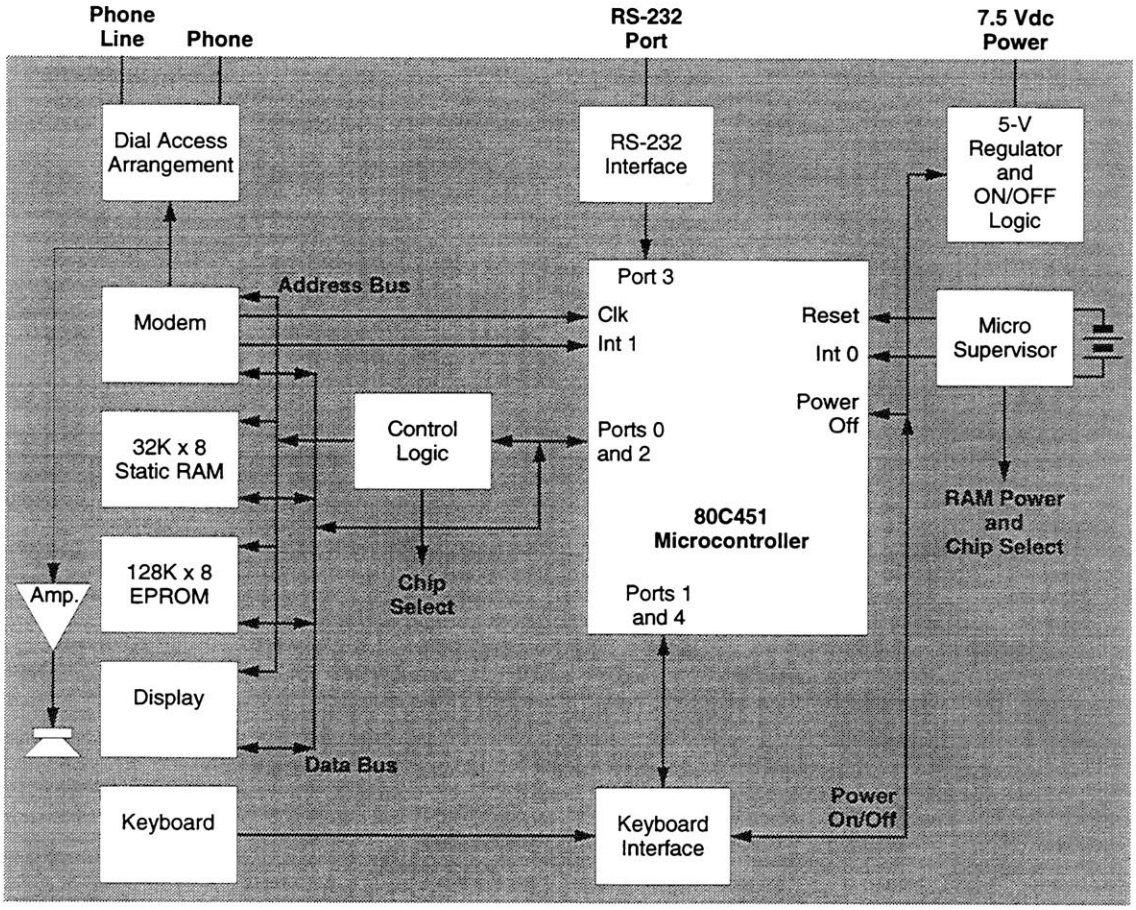


Figure 5-1 Block Diagram of the AlphaMate 250

2 The Microcontroller

All operations of the AlphaMate 250 are controlled by an 80C451 Microcontroller. It provides seven 8-bit I/O ports, two 16-bit counter/timers, one serial port, two external interrupt inputs, and 128 bytes of internal RAM.

Two of the seven I/O ports are used jointly to derive the 8-bit data bus and the 16-bit address bus to the RAM, EPROM, and other circuitry. The remaining five I/O ports are used directly to control various subsystems. A complete list of the connections to the 80C451 is shown in table 5-1.

The external memory space accessed by the Microcontroller is divided into two types: that used for program code (EPROM), and that used for data (RAM and interface circuitry). The space used for data is broken down as shown in table 5-2.

The Microcontroller provides a Universal Asynchronous Receiver/Transmitter (UART) on port 3. This is used to control the modem and the RS-232 interface. The UART can be programmed for various baud rates (300 to 9600 baud) and flow control formats (7-bit or 8-bit data, 1 or 2 stop bits).

Timer pins T0 and T1 on port 3 are not used for their usual functions. Instead, T1 is used to generate the CTS (Clear To Send) signal, and T0 is used to generate the RTS (Request To Send) signal for the serial interface. These pins are controlled by software.

Table 5-1: 80C451 Microcontroller Pin Assignments

Port	Pins	Signal Name	Description
0	0-7	AD0-7	Multiplexed data and low-order address buses
1	0-6	KSFRC0-6	Keyboard scanning forcing lines
	7	PPPBUSY	Busy input from printer port, for polling
2	0-7	A8-15	High-order address bus
3	0	RXD	Serial port receive data
	1	TXD	Serial port transmit data
	2	PFINT	Power-fail interrupt
	3	MDINT	Modem interrupt
	4	RTS	Serial port ready-to-send
	5	CTS	Serial port clear-to-send
	6	WR-	External data memory write strobe
	7	RD-	External data memory read strobe
4	0-7	KSDET0-7	Keyboard scanning detection lines
5	0	CNTRL	Keyboard row select
	1	RI-	Ring indication from Dial Access Arrangement
	2	OFFHOOK-	Offhook signal to Dial Access Arrangement
	3	PWR-	Power on latch control
	4	WDT-	Watchdog timer strobe
	5	FLASHPRG	FLASH memory program enable

3 Memory (RAM and EPROM)

The AlphaMate 250 contains 32K bytes of battery-backed static RAM (Random Access Memory) for storing data, and 128K bytes of EPROM (Electronically Programmable Read-Only Memory) for storing program code.

The RAM is controlled by the Micro Supervisor circuit. This circuit controls chip selection when the RAM is written to and read from. This circuit also safeguards stored data in two ways. It ensures that the RAM cannot be written to during power-up and power-down. And it ensures that stored data is maintained by a backup battery while the AlphaMate 250 is off.

The EPROM is divided into eight 32K-byte banks. The low-order bank (hexadecimal addresses 0000 - 7FFF) is always accessible to the Microcontroller. The remaining seven banks (addresses 8000 - FFFF) are bank-switched.

Table 5-2: Memory Map

Address Range (Hexadecimal)	**Chip Select**	**Device**
0000 - 7FFF	RAMCS0-	Battery-backed static RAM, 32K bytes
8000 - FDFF	RAMCS1	Battery-backed static RAM, 32K bytes
FE00 - FE7F	MODEMCS-	Modem
FE80 - FEFF	LCDE	Liquid crystal display
FF00 - FF80	ALTCH-	Addressable latch (address/data demultiplexing)

4 Keyboard and Keyboard Interface

The keyboard is arranged as a matrix of 8 forcing lines (columns) by 16 sense lines (rows). Only 14 of the rows are used. The keyboard actually provides 68 keys in this matrix: the ON key is handled separately.

The Microcontroller scans the keyboard by pulling one of the eight forcing lines at a time low while the others are allowed to float on their open-drain outputs. While one line is held low, the Microcontroller scans across the 16 sense lines looking for an operated key. Only one key can be operated at a time except for SHIFT or CTRL, either of which can be combined with another key.

Port 1 on the Microcontroller provides the forcing lines for the keyboard (KSFRC0 - KSFRC6). These lines are filtered at the KEYBOARD ROW CONNECTOR.

The sense lines from the keyboard (KROW0 - KROW16) originate from the KEYBOARD COLUMN CONNECTOR. These lines are filtered and connected to pull-up resistors. The resulting signals are multiplexed by a 2-to-1 multiplexer into the 8 pins of port 4 on the Microcontroller. Pin 0 from port 5 is used to select odd or even lines.

The ON key is handled entirely separately from the other keys. This key provides a signal to a MOSFET, which in turn activates the Micro Supervisor.

5 Liquid Crystal Display

The liquid crystal display provides information to the user through a 2-line display with 40 characters per line. This display subsystem incorporates both the display itself and the required driver chips on a small printed-circuit board linked to the main circuit board through a ribbon cable.

The display is treated as a memory device by the microcontroller. A bus transceiver derives eight data bits for driving the display. A line driver derives other control signals for the display. These lines are filtered and terminated on the ribbon-cable connector.

The contrast of the display is controlled by software. A digital potentiometer converts the software data to a signal to the display.

6 Modem and Dial Access Arrangement

In most cases the AlphaMate 250 communicates with one or more paging systems over a standard analog telephone line. This line is accessed through a Modem and a Dial Access Arrangement.

The Modem is implemented using a single chip. This chip provides the following characteristics:

- It is compatible with Bell standard 103 communication at 300 baud.
- It interfaces directly with the Microcontroller.
- It provides call progress detection of busy, ringback and dial tones.
- It generates DTMF and guard tones.
- It can make analog loopback, digital loopback, and remote digital tests.

The Dial Access Arrangement includes a hybrid circuit that converts the 2-wire telephone line into separate transmit and receive channels for the modem chip. A relay functions as a hookswitch, and is also used to generate dial pulses.

The AlphaMate 250 is protected from voltage surges on the telephone line in two ways. Two positive-coefficient resistors protect against long-term surge voltages. Two chokes and a surge suppressor protect against large, short-term surges resulting from lightning strikes on the telephone line.

The signals on the line side of the modem are also passed to an audio amplifier that drives the speaker. The gain of the amplifier is controlled by software. A digital potentiometer converts the software data to a signal to the amplifier.

7 RS-232 Interface

The RS-232 interface provides a serial port that can be used in several ways:

- It can be used for a direct connection to a paging terminal instead of a dial-up telephone line.
- It can be used as a direct link to another AlphaMate 250 for downloading/uploading the directories.
- It can be used for a serial printer.

The serial port shares the functionality of the modem chip with the telephone line interface. Other signals are derived directly from the Microcontroller. The serial port is turned on and off at appropriate times so that it does not interfere with the functions of the modem chip.

Filters and protection circuitry are provided at the RS-232 connector.

8 Power Supply and Micro Supervisor

Power for the AlphaMate 250 originates from a wall-mounted adaptor. Adaptors are available for either 115 Vac or 230 Vac, at 50-60 Hz. Both adaptors provide a minimum of 7.5 Vdc to the AlphaMate 250, with a minimum of 250 mA.

The 7.5-Vdc power passes through a latching circuit that is turned on by the ON switch, and off by software. The resulting power is applied to a 5-V linear regulator, and distributed to the various circuitry in the AlphaMate 250 as four separately filtered supply lines.

The Micro Supervisor chip provides power to the RAM chips and the real-time clock, and supervisory signals to the Microcontroller. The power to the RAM chips and the real-time clock is derived either from the main power supply (if it is on), or from a 3-V lithium battery (if the power supply is not on).

The Micro Supervisor switches the RAM also provides the following supervisory functions:

- It resets the Microcontroller during power-up, power-down, and brown-out conditions.
- It write-protects the RAM during power-up, power-down, and brown-out conditions.
- It provides a watchdog timer that resets the Microcontroller if it has not been toggled during a specified time; then ensures that the Microcontroller does not "hang".
- It uses a threshold detector to provide a warning of imminent power failure.
- When power fails completely, it interrupts the Microcontroller.

Section Six: Servicing Information

1 Troubleshooting

Some common problems, their possible causes, and their solutions, are presented in table 6-1.

Table 6-1: Common Problems, Causes, and Solutions

Symptom	Possible Cause	Solution
Unit does not power up.	1) Power supply not plugged into source.	Plug in supply.
	2) Power supply not plugged into unit.	Plug in supply.
	3) Power supply not working.	Replace power supply.
	4) Power ON/OFF circuit in AlphaMate 250 is defective.	Repair or replace circuit board.
Unit does not seize telephone line.	1) Telephone line not connected.	Connect telephone line.
	2) Telephone cable defective.	Replace cable.
	3) Modem in AlphaMate 250 is defective.	Repair or replace circuit board.
Printer does not respond to printouts.	1) Printer not turned on.	Turn on printer.
	2) Printer not on-line.	Put printer on-line.
	3) Printer cable is not connected.	Connect printer cable.
	4) Wrong printer cable used.	Verify the cable against table 2-4.
	5) Printer set up wrongly.	Check the setup as described in this manual and in the printer manual.

Note: The various connections to the AlphaMate 250 are described in detail in

section 2, Installation.

More subtle problems can be detected by the diagnostic routines built into the AlphaMate 250. The following functions can be tested:

- Modem Digital Loop,
- Modem Analog Loop,
- Keyboard,
- LCD Blank,
- LCD Pixel,
- LCD Contrast,
- LCD Character,
- RAM.

Complete details for using these diagnostic routines are provided in section 3, Testing the AlphaMate 250.

2 Opening the Case

The AlphaMate is enclosed in a case that consists of two parts joined at a seam around the middle. The two parts are locked together by catches. To open the case of the AlphaMate 250, follow the instructions below.

1. Remove the two screws from the EIA RS-232C connector (see figure 6-1).

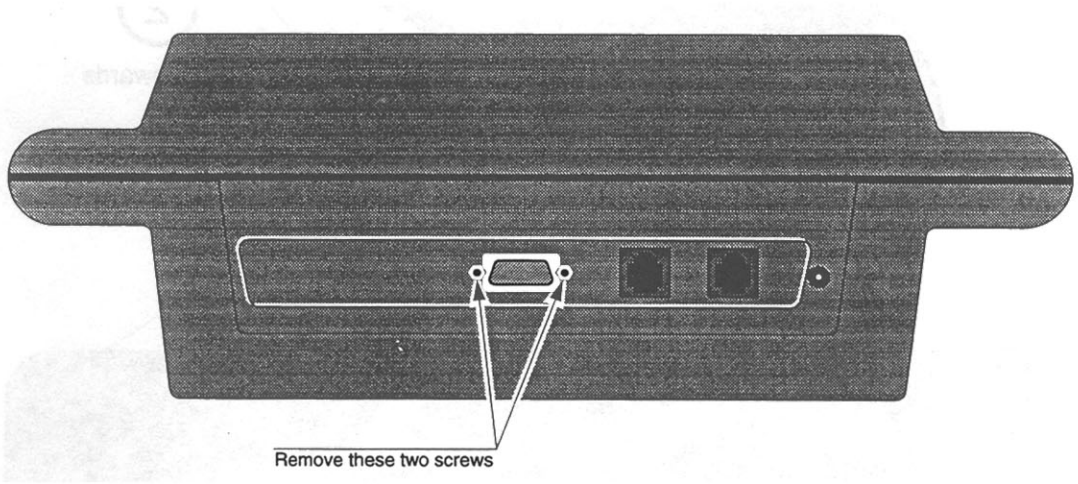


Figure 6-1: The Connectors on the Back of the AlphaMate

2. Place the AlphaMate 250 upside-down on a table, and observe the two catches in the upper corners of the case. Insert a flat-blade screwdriver into the outer slot of one or the catches (see figure 6-2). Twist the screwdriver as shown in the illustration. When the catch disengages, pry upwards on the screwdriver handle. This forces the top and bottom parts of the case to slide apart along the one side.
3. Repeat step 2 for the other catch.
4. Slide the top and bottom of the case until the catches disengage completely. Separate the two halves carefully so that ribbon cables and connectors are not damaged.
5. The various parts of the AlphaMate 250 can now be disconnected (see figure 6-3). Begin by unplugging the speaker cable from the circuit board (connector D) so that you can completely separate the top and bottom housings.

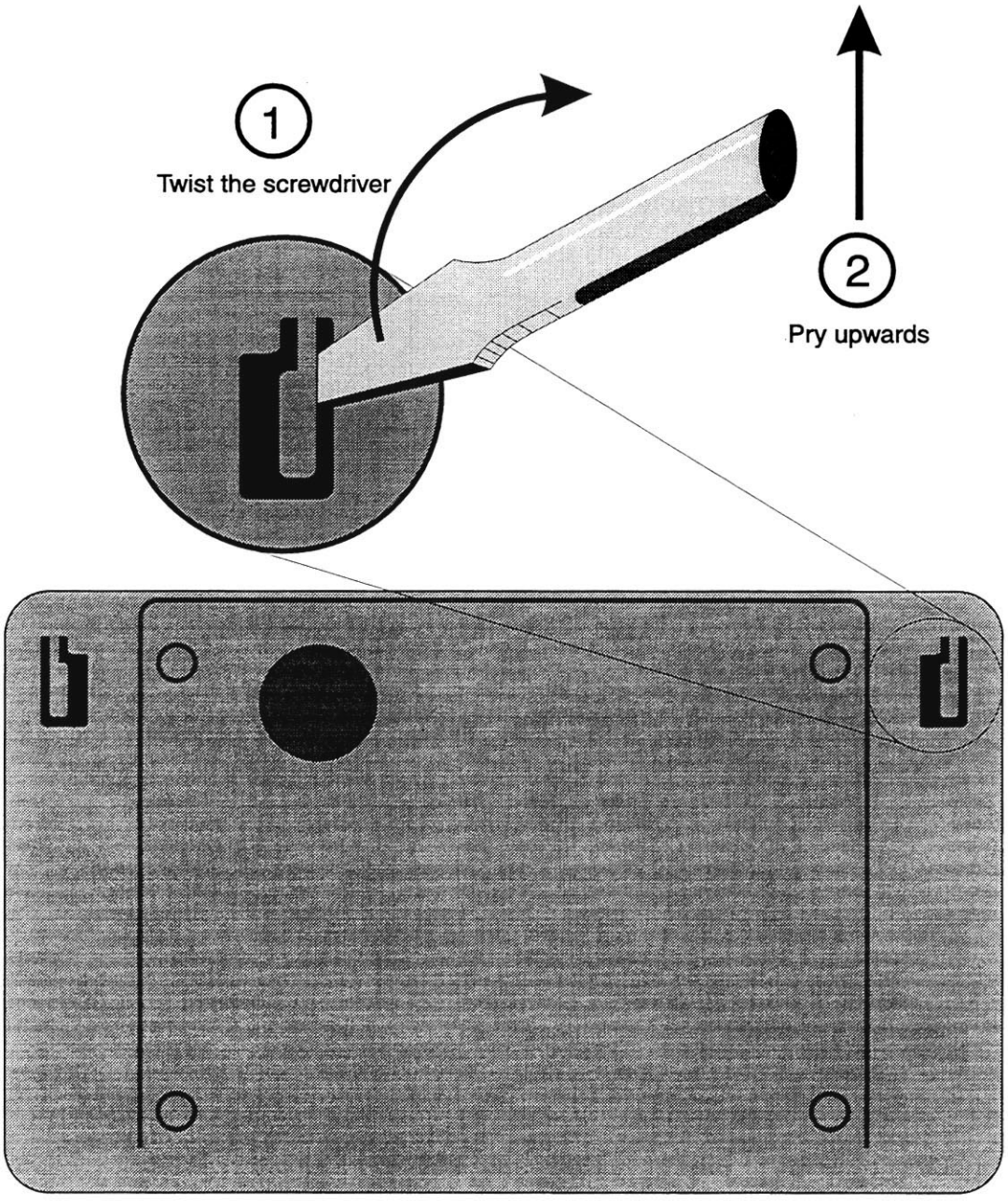


Figure 6-2: Unlocking the Catches

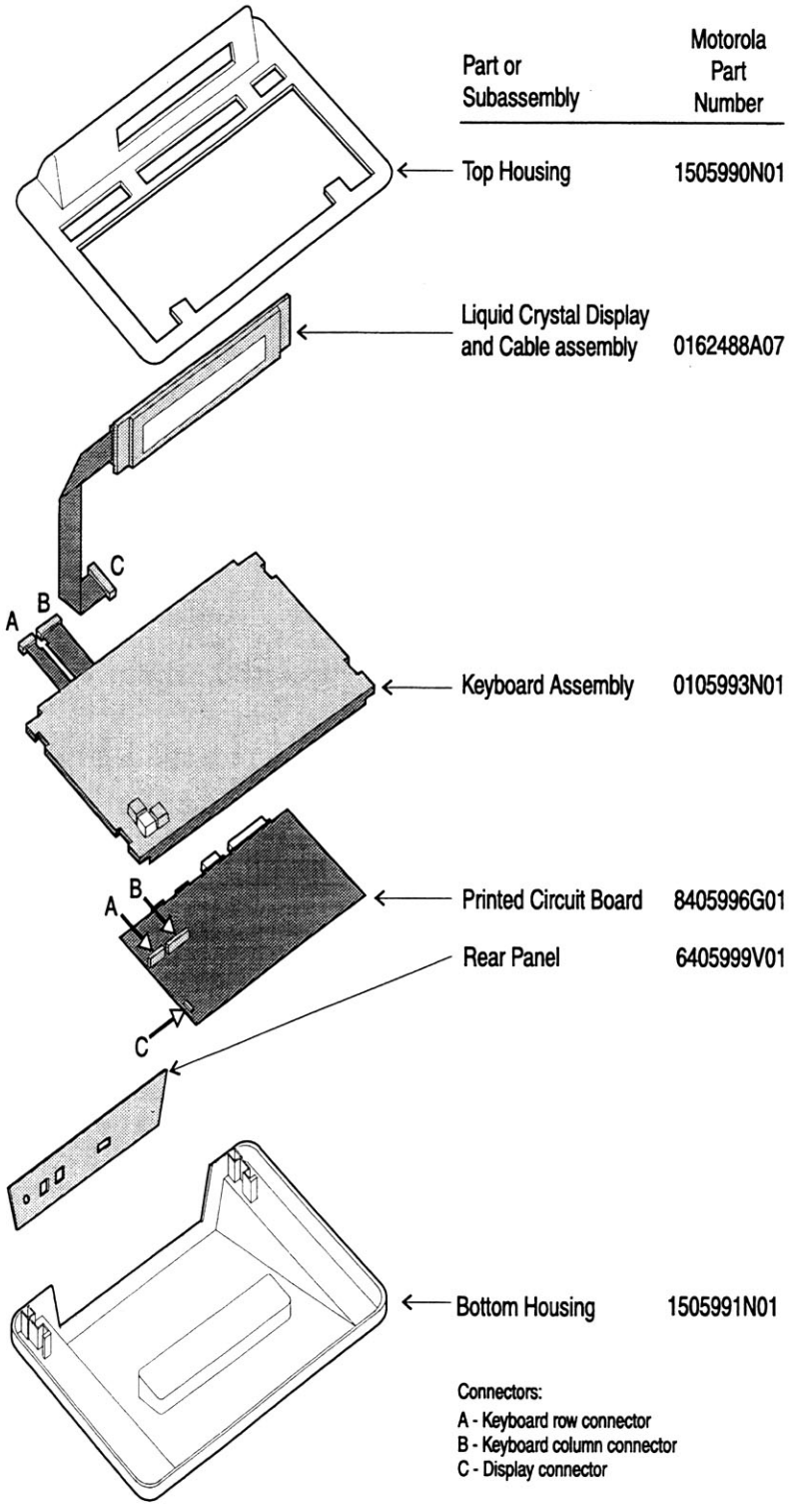


Figure 6-3: AlphaMate 250 Exploded View

3 Closing the Case

To close the AlphaMate 250 case again, follow the instructions below.

1. Reassemble any parts or subassemblies within the AlphaMate 250, and make sure that all internal cables are re-connected, as indicated in the exploded diagram (see figure 6-3).
2. Place the top and bottom housings together so that the catches are aligned.
3. Slide the top and bottom housings together so that the catches engage and snap closed.
4. Replace the two screws in the RS-232C connector (see figure 6-1).
5. Reconnect the power and other cables to the unit, and restore it to service.

4 Replacing the Battery

The lithium battery used to keep the RAM operational while the AlphaMate 250 is switched off has a lifetime of at least five years. To avoid losing the stored directories, it is wise to replace the battery after five years of use.

In order to change the battery without losing directory information, you need a second AlphaMate 250. The directory information in the second unit will be lost in the process, so this should be a unit that is currently spare. You will also need to establish a connection between the two AlphaMate 250s. You can use a direct link between the RS-232 ports; or, if each unit is already connected to a telephone line, you can simply dial-up one unit from the other. Complete details for this procedure are provided in the *AlphaMate 250 Operator's Manual* (6880450F40), Appendix B, Working With Remote AlphaMate 250s.

The procedure is as follows.

1. Establish a remote connection between the two AlphaMate 250s.
2. Download the unit that needs the new battery into the other unit. This saves all the directories.
3. Disconnect the unit that needs the new battery from power and from the other AlphaMate 250.
4. Open the unit as described in part 2 this section.
5. Unsolder and remove the old battery (see figure 6-4).

CAUTION
Discard the battery according to the instructions provided by its manufacturer. Lithium batteries contain potentially hazardous compounds.

6. Solder in the new battery.

DANGER
If the battery is installed incorrectly there is a danger of explosion. Replace the battery only with the same or an exactly equivalent type.

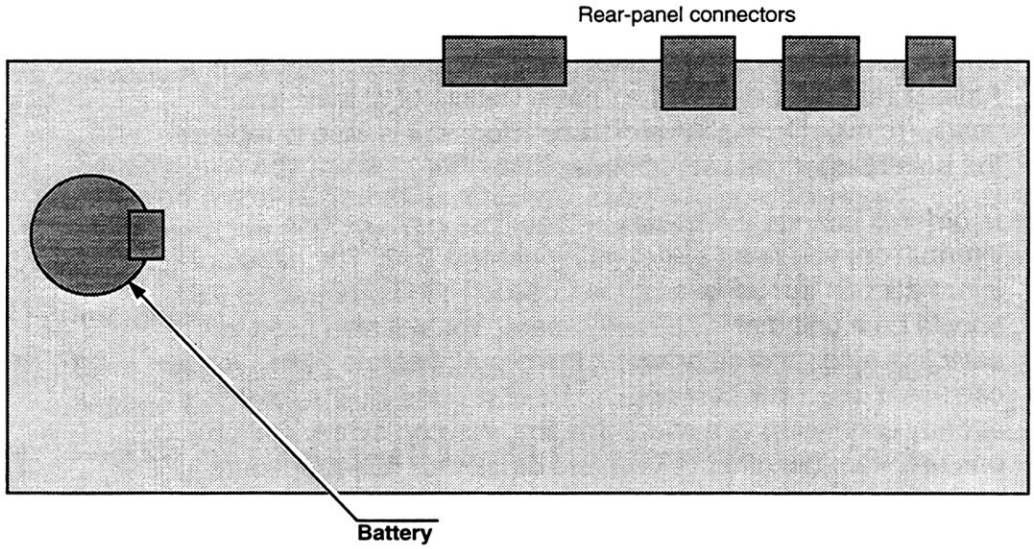


Figure 6-4: The Location of the Battery on the Circuit Board

7. Reassemble the AlphaMate as described in part 3 of this section.
8. Connect the AlphaMate to power, and turn it on.
9. Re-establish the remote connection between the two AlphaMate 250s, as in step 1.
10. Download the directories from the second unit back into the original unit. This restores all the saved directories.
11. Disconnect the two units, and restore the original AlphaMate 250 to service.